DECAY METHOD FOR MEASURING COMPLEX DIELECTRIC CONSTANTS DURING MICROWAVE PROCESSING

Q. Jiny and M. Barmatz
Jet Propulsion Laboratory, California Institute of Technology
Pasadena, CA 91109

ABSTRACT

We have developed a fast in-situ method for measuring the quality factor, Q, and resonant frequency, f_r, for an isolated microwave resonant mode. The mode resonant frequency was continuously monitored using a phase modulation frequency tracking technique. The quality factor was determined by periodically switching off the microwave power and fitting the decay curve to an exponential. The cavity perturbation method was used with small samples ($ka << 1$). Combining the Q and f_r data with a non-contact measurement of the sample temperature permits the calculation of the temperature dependence of the real (c') and imaginary (E") dielectric constants. Because of the speed of this technique (= 1 μsec), it can be use-d during processing to continuously *measure the* dielectric constants of the material without perturbing the sample temperature. Measurements were performed using an isolated TM 010 cylindrical cavity mode with f_r = 4.8 GHz. Care was taken to minimized the perturbing effects of the sample support. The accuracy of the frequency tracker was verified at room temperature from measurements on several alumina spherical samples that yielded $\varepsilon' = 9.9 \pm 0.1$ in agreement with published values. The decay technique was also verified from measurements on several small spherical Teflon samples that yielded $\varepsilon' = 3.33 \pm 0.04$, $\varepsilon'' = 0.079 \pm 0.01$. [Work supported by NASA].